



Effect of Addition of a Combination of Spirulina sp Flour and Earthworm Flour (*Lumbricus rubellus*) in Artificial Feed on Color and Growth of Goldfish (*Carassius auratus*)

Mulis, Sitti Intan Delliana Ayub, Arafik Lamadi

Faculty of Fisheries and Marine, Gorontalo State University

E-mail: mulis@unq.ac.id

ABSTRACT

Brightness of color is one of the factors that goldfish are in demand by the public. Feed containing carotenoids can affect the color pigment of fish. This study aims to determine the effect of the combination of Spirulina sp flour and Earthworm flour on color brightness and growth of goldfish. The method used is an experiment with a completely randomized design (CRD) which consists of 4 treatments with 3 replications. Treatment A (without the addition of flour), B (2% Spirulina flour, 10% Earthworm flour), C (4% Spirulina flour, 12% Earthworm flour), D (6% Spirulina flour, 14%). The results showed that treatment C had an effect on increasing the color of goldfish with an average value of 9.19, followed by treatment D with a value of 8.63, treatment B with a value of 7.52 and treatment A with a value of 6.30. This study shows that the addition of a combination of Spirulina flour and Earthworms can increase the color of goldfish.

Keywords: *Carassius auratus*, Brightness, *Lumbricus rubellus*, *Spirulina sp*

I. Introduction

Goldfish (*Carassius auratus*) is a type of ornamental fish that is very popular with the public because of its morphology and various color combinations (Hartono & Ninik, 2010). Goldfish have body shapes and colors that vary from yellow, red, black to silvery (Fazil et al., 2017). Several factors that can affect the color of fish include genetic factors, health and glandular factors, and feed. In genetic factors, fish inherit color from their parents. Then in terms of health, the better the color of the fish indicates the fish is healthy. Likewise for glandular factors related to hormones, usually a strong color is found in male fish than in females. Feed containing nutrients and chemicals can affect the color pigment of fish (Kaur & Tarang, 2017). One effort to increase color brightness in ornamental fish is to add a pigment source to the feed.

Earthworms and Spirulina contain nutrients needed by fish so that they can be used as feed. Fadaee (2012) stated, Earthworms contain 65.24% protein, 11% fat, 6% ash and 19% nitrogen without extract. Spirulina sp. is one type of microalgae that is widely cultured and sold commercially in dry form as a food supplement. This microalgae has a high nutritional content, namely: protein content 55-70%, carbohydrates 15-25%, essential fatty acids 18%, and the rest are vitamins, minerals and pigments, namely: chlorophyll, carotene, xanthophyll and phycocyanin (Pankey, 2007). 2009). Based on this, the authors are interested in conducting research on "The Effect of Adding a Combination of Spirulina sp Flour and Worm Flour (*Lumbricus rubellus*) in Artificial Feed to the Color of Goldfish (*Carassius auratus*)".



II. RESEARCH METHODS

This research was conducted in April – May 2021 at the Tatelu Freshwater Aquaculture Center (BPBAT), Tatelu Village, Dimembe District, North Minahasa Regency, North Sulawesi Province.

1. Research methods

This research is an experimental study, the design used is RAL (Completely Randomized Design). This research was conducted with 4 treatments and 3 replications, the test variables were the color and growth of goldfish.:

A = 100% pellet/control

B = 88% pellet, 2% Spirulina Flour, 10% Earthworm Flour

C = 84% pellet, 4% Spirulina Flour, 12% Earthworm Flour

D = 80% pellets, 6% Spirulina Flour, 14% Earthworm Flour.

2. Research procedure

The type of feed that will be used during the study is artificial fish pellets mixed with Spirulina sp flour and Earthworm flour according to the treatment. The stages of mixing spirulina sp flour and earthworm flour in feed according to (Uly, 2017) that is :

1. Mix the Spirulina sp flour and Earthworm flour according to the dose with the progol (2-3g/kg) in one container and stir until evenly distributed, then add water at a dose of 150 ml/kg to the Spirulina sp flour and Earthworm flour then leave for 10 minutes.
2. Mix the feed into a container of Spirulina sp flour and Earthworm flour with progol which has been dissolved in water, stir the feed mixture with the progol until all the Spirulina sp flour and Earthworm flour are evenly mixed.
3. The feed mixture with Spirulina sp flour and Earthworm flour is dried for 30-60 minutes

III. RESULTS AND DISCUSSION

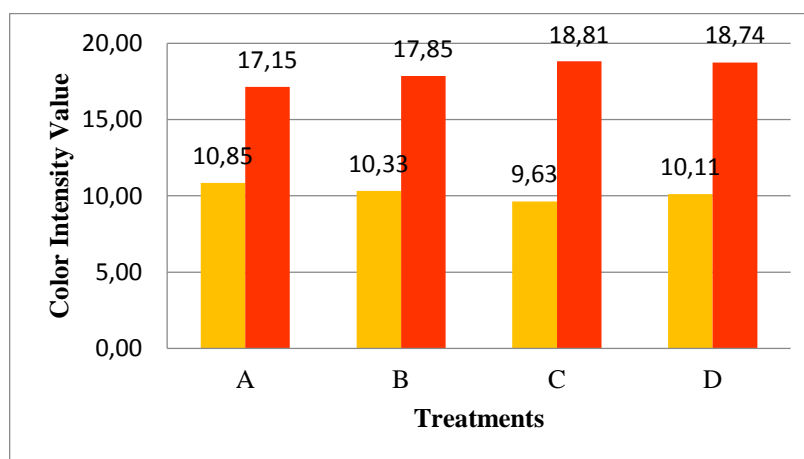
1. Color Brightness Level

The application of Spirulina sp flour and Earthworm flour in the diet of goldfish showed a different color increase. The results of the research on the brightness level of goldfish showed an increase in each treatment. The highest changes in goldfish were found in treatment C (4% Spirulina 12% Earthworms) and treatment D (6% Spirulina 14% Earthworms) followed by treatment B (2% Spirulina 10% Earthworms) and the lowest was in treatment A (0 % Spirulina 0% Earthworm).

The smallest color increase occurred in treatment A without the addition of Spirulina flour and 0% Earthworm flour with an average value of 6.30, this is because goldfish cannot produce carotenoids themselves so they need additional carotenoids. Lestari et al., (2019) states that carotenoids are the main components that make up the red and yellow pigments. Fish cannot synthesize it on their own, but they get it from food. Fish have different abilities in the absorption of carotenoids, this causes different levels of absorption in each treatment. Treatment B with a dose (2% Spirulina and 10% Earthworm) from 10.33 to 17.85 with an average value of 7.52. according to Amin et al., (2012) The different increase in each treatment was due to the different absorption rates of color pigments and carotene sources by fish.

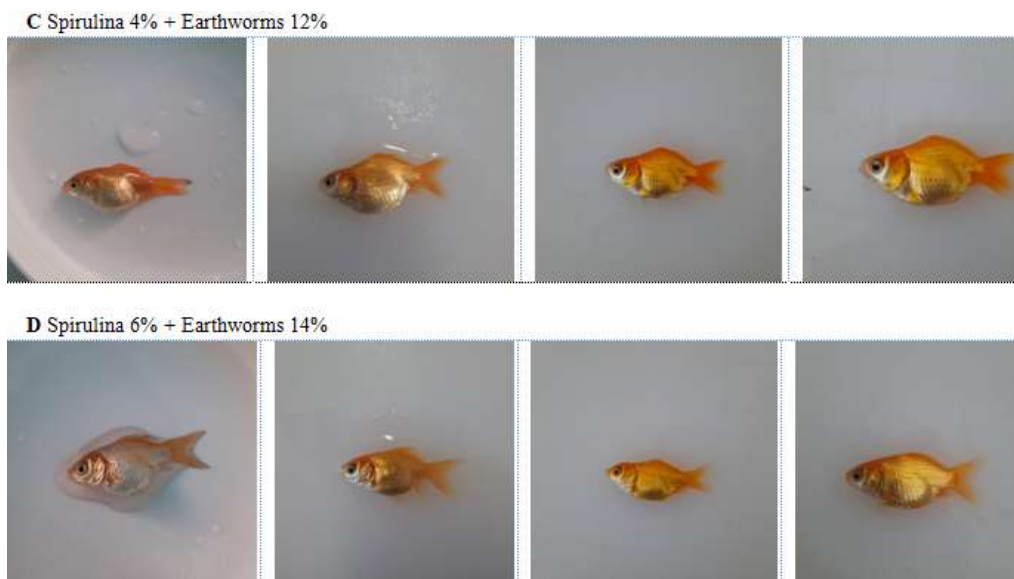
Treatment D with a dose (6% Spirulina and 14% Earthworm), from 10.11 to 18.74 with an average value of 8.63. Treatment D is less than optimal because the feeding exceeds the limit of

the goldfish's ability to absorb and accumulate carotenoid sources that are received so that it affects hormones in their work. Fish need a longer time to be able to decompose carotenoids into color pigments if the amount of pigment present in the feed for the fish is too much.(Kurniawati et al., 2012). At higher doses, excess carotenoids cannot be digested by the fish's body, but are excreted through the feces (Amin et al., 2012). Observations on fish treated with Spirulina flour and Earthworms increased on average, but the increase had a different value. Treatment C (4% Spirulina and 12% Earthworm) was the treatment that had a large color increase of 9.19. The high increase in color in treatment C was thought to be due to the ability of goldfish to absorb and the amount of beta-carotene present in Spirulina and Earthworms was sufficient in the pigment absorption process so that the pigment absorption process resulted in better color.



Picture1. Goldfish Color Upgrade Graphics





Picture2. Goldfish Color Improvement

Andriana et al., (2018) stated that, the increase in color was thought to be because goldfish still needed carotenoids in their feed to synthesize color, besides that the absorption and metabolism of fish worked optimally because the dose given was in accordance with the fish's ability to synthesize carotenoids.

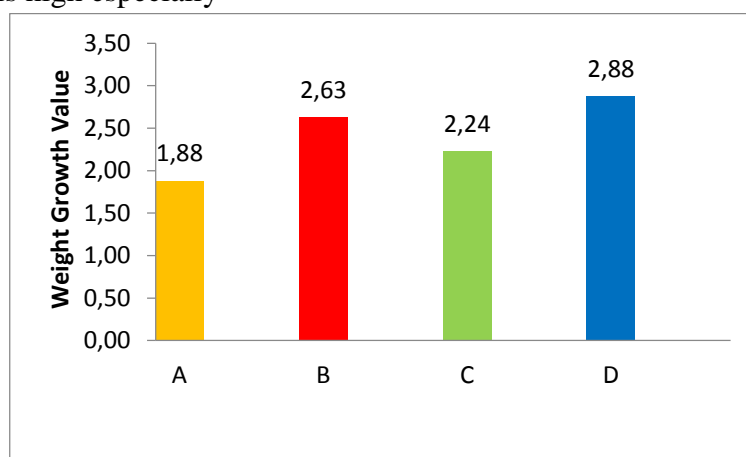
Indarti et al., (2012) stated that the carotenoid content in Spirulina flour can increase the number of chromatophores cells. Chromatophore cells are pigment cells that have a spherical shape and are located spread throughout the epidermal cell layer of fish skin. The pigment granules scattered in the cells cause the cells to absorb light perfectly, resulting in an increase in the color of the scales which causes the color of the scales in fish to become lighter and clearer, while the pigment granules that gather near the nucleus cause a decrease in the color of the scales so that the color of the fish looks darker and faded. . Ukhroy (2008) also argues that the formation of color in the fish body is due to the presence of pigment cells located in the epidermis layer.

Spirulina sp is a blue green algae rich in protein, vitamins, minerals and other nutrients. Spirulina contains phycocyanin, chlorophyll and carotene. Carotene is composed of xanthophyll (37%), beta carotene (28%) and zeaxanthin (17%) (Tongsiri et al., 2010). In addition, earthworms also contain beta carotene, essential fatty acids, namely linoleic fatty acids, EPA and DHA and contain high omega 3 and 6 (Astuti, 2001 in Saputri, 2018). The addition of Spirulina flour and Earthworm flour to the feed will stimulate an increase in color pigment in the fish's body during rearing. The appropriate nutritional content can improve the performance of the fish's color to be brighter. The high content of protein and carotenoids is thought to increase the color intensity of goldfish (Noviyanti et al., 2015). The carotenoid content in Spirulina flour and Earthworm flour mixed in the feed was not damaged, because after printing the feed was not dried using a high temperature, the feed was only dried in the sun so that it did not have a high water content.

2. Absolute Weight Growth

Observation of absolute weight is a parameter that is observed to determine the effect of the combination of Spirulina flour and Earthworm flour on the feed. The highest average absolute weight growth rate at the end of the study was treatment D of 2.88 g, presumably because the protein contained in D feed containing Spirulina and Earthworm Flour met the nutritional needs of goldfish and was able to absorb nutrients well, then treatment B 2.63 g, treatment C 2.24 g, and treatment A 1.88 g. The best increase in weight growth occurred in treatment D. According to Andriasnyah et al., 2020, that the nutritional content contained in the treatment feed has the potential to support the growth of goldfish fry. In addition to protein, fat also affects growth, this is because fat is one source of energy that must be available in feed, if fat is not sufficient then the energy used for fish seed activity is taken from protein so that fish growth can be inhibited.

Natalia et al., (2019) stated that the protein from dried Spirulina sp can reach more than 60%, the vitamin content is high especially



Picture3. Goldfish Absolute Weight Growth Chart

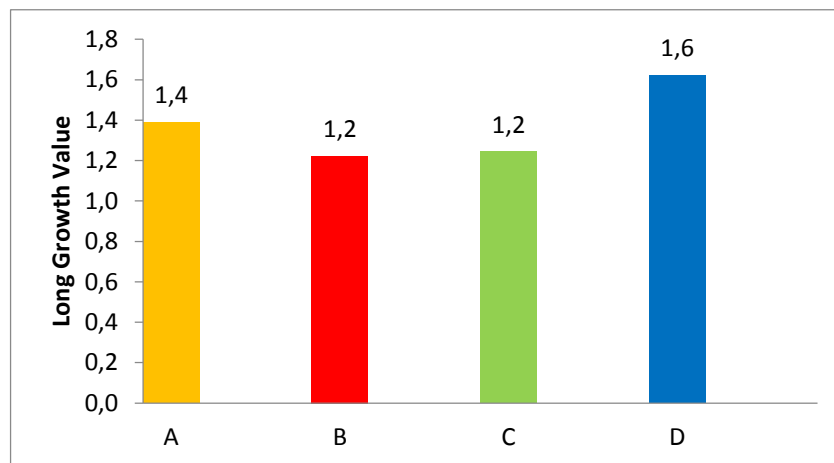
vitamin B12, and contains a fairly complete amino acid. This is also supported by the statement Nurhayati et al., (2019) Earthworms contain the nutrients needed by the fish's body, so they can be used as feed. The higher the substitution of earthworm flour, the protein and fat content of the feed will affect the energy levels and the composition of essential amino acids of feed which are needed by the fish body for growth. (Nurhayati et al., 2019). Fish growth is related to the availability of protein in feed, because protein is a source of energy for goldfish, besides protein is a nutrient that is needed for growth. The level of protein in the feed is influenced by the non-protein energy content derived from carbohydrates and fats. Treatment A (control) resulted in the lowest growth in goldfish. This is presumably because the protein content is too high, causing growth to be stunted.

Suyono, (2001) stated, feed with high protein content but energy from non-protein (fat and carbohydrates) is not balanced, will cause the conversion of relative protein into energy. Excess and lack of nutrients in fish feed will have a negative impact on fish. Excess protein in fish is also not good for growth because excess protein can trigger metabolism for the process of protein absorption in the body of high fish so that excess energy is needed. (Nazhiroh et al., 2019). While in treatment D, the highest results were obtained because the nutritional content needed by fish was able to be met by feed from treatment D.

Treatment C has a low value in weight growth, but at increasing color brightness, treatment C has the best value. It is suspected that the feed given with the addition of 4% Spirulina flour and 12% Earthworm flour was only used by fish in changing color brightness. Ornamental fish fed with carotene sources are thought to be more likely to use these dyes to increase their body color (Prayogo et al., 2012). Barus et al., (2014) stated that the addition of carotenoids to the feed did not affect the growth of goldfish. In addition, this is due to the response that the feed given to the fish cannot meet the needs (energy) for the growth and development of fish. The increase in weight in the treatment was caused because each feed was given a response by the fish and was used for metabolic and growth processes (Rachmawati, 2012).

3. Absolute Length Growth

The results showed that the average change in body length during the observation of each treatment increased during maintenance, namely in treatment D by 1.6 cm and followed by length growth in treatment A by 1.4 cm, treatment C 1.2 cm, treatment B 1.2 cm. In contrast to weight growth, treatment B on this length growth had the lowest value. This is related to the protein content of the feed given during the treatment which was less than the treatment given the combination of Spirulina flour and Earthworms. So that protein can not be utilized optimally which causes the absolute length growth is relatively low.



Picture4. Goldfish Length Growth Chart

Mutiarasari, (2017) stated that the increase in length was influenced by the feed given during maintenance, not only sufficient and on time, the feed must also have sufficient nutritional and nutritional content, if the fish consume feed with low nutritional content, their growth will be stunted.

The growth of the average length of goldfish was the highest in treatment D. In this treatment, it was assumed that it had a balance of energy and protein that met the fish's needs, so that fat and carbohydrates could be utilized in the growth of the fish. Fish growth is strongly influenced by feed because feed has a very important role in aquaculture activities. Intensive fish farming activities use artificial feed to accelerate fish growth (Fitriana et al., 2013). Digested feed will produce an energy supply. The feed energy obtained will be used for body metabolism and the rest will be used for growth (Nishrina et al., 2013). In treatment B resulted in low growth of goldfish growth. It is suspected that the protein content in feed B contains less protein, so that the nutrients



in the goldfish's body for growth are not sufficient. The protein requirement of omnivorous fish is around 25-30%, the feed given according to the protein needs of the fish results in good absorption of nutrients for growth (Nazhiroh et al., 2019). The growth in length is relatively smaller than the growth in weight. This means that digested food used for growth is more focused on weight growth than for long growth processes.

4. Life sustainability

Survival is the chance of an individual living in a certain time. The percentage of survival (survival) is influenced by abiotic factors such as the ability to adapt to the environment, human handling, population size, competitors, disease, age and the presence or absence of predators. (Nasir & Khalil, 2016). In this study, in addition to looking at the brightness of the color, growth, also looking at the survival rate of goldfish at the end of the study. Survival rates in all treatments obtained 100% survival. The high survival rate of fish is influenced by environmental conditions and maintenance media that are still feasible to support fish maintenance

Level 100% survival in all treatments was due to the nutrients from the feed that met the needs of the fish. In addition, timely feeding and handling of water quality are still within tolerance limits which are other elements of 100% survival. The low stocking density of goldfish during maintenance so that goldfish have a wide range of motion. According to Rosid et al., (2019), that this is because *Spirulina* sp contains blue pigment or phycocyanin which can increase fish immunity. In addition, earthworms also have nutritional value that can be used as immunostimulants because the active substances possessed by earthworms are antibacterial pathogens that can increase immunity (Julendra & Sofyan, 2007).

5. Water quality

The temperature during the study was carried out at the same time and the research place was in a closed room so that the outdoor conditions that often changed did not affect the research container. The average value during the study was obtained the temperature range in the morning was around 25.3 oC, while in the afternoon it was around 25-26oC. High temperatures will increase metabolism so that fish appetite increases (Antono, 2010). A good temperature for aquaculture is around 22-30oC (Muarif, 2016).

The range of pH measured in the morning and evening in the maintenance container for each treatment ranged from 7.66 to 7.68. according to (Lesmana et al., 2009), that the optimal pH in the maintenance of goldfish ranges from 6.5 to 8.0. So that the pH in the rearing container does not interfere with the growth and survival of the test fish. Mark Dissolved oxygen during the study obtained in the morning ranged from 7.5-7.6 and in the afternoon ranged from 7.4, dissolved oxygen (DO) in goldfish rearing was in the optimal range. The DO value shows the amount of Oxygen (O₂) available in a water. The higher the DO value in the water, it indicates the water has good quality for fish rearing, on the contrary if the DO is low, it can be seen that the water has been polluted and is not suitable for fish rearing. The DO value that is not suitable for maintenance can have an impact on the growth rate and the respiratory process of fish. In general, the oxygen content of 5.0 ppm with water temperatures ranging from 20.0-30.0 °C is still relatively good for the life of fish (Marasabessy et al., 2010).



IV. CONCLUSION

1. The use of a combination of Spirulina sp flour and Earthworm flour in feed has an effect ($p > 0.05$) on the color and length growth of goldfish
2. The addition of 4% Spirulina flour and 12% Earthworm flour (treatment C) resulted in the best color change rate, while for the best growth in weight and length the addition of 6% Spirulina flour and 14% Earthworm flour (treatment D).

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